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ABSTRACT

This study investigated the effects of selected physiological variables on preadolescent male and female long distance runners. The trained group was comprised of 20 children between the ages of 8 and 10 who had been running a minimum of 20 miles per week for two months or longer. The control group was made up of 20 children of the same ages who were not participating in an organized recreational sport. The physiological parameters compared were maximum oxygen consumption, bone density width, cortical score, and bone mineral content. The findings suggested that participating in long distance running was advantageous for the runners. A bibliography is included. (JD)

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THE EFFECTS OF LONG DISTANCE RUNNING ON PREADOLESCENT CHILDREN

N. Kay Covington

Paper presented at the National Convention of the American Alliance for Health, Physical Education, Recreation and Dance. Las Vegas, Nevada, April, 1987

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INTRODUCTION

Children are participating in organized sports at earlier ages and in greater numbers. New and popular sports are attracting our youth (Brueck, 1979). More than 6 million youth are involved in a wide variety of high school sports today. Twenty million youth between the ages of 8 and 16 are in non-school, community-sponsored athletic programs (Zito, 1983). One of the new sports activities in which children are involved is long distance running. Long distance running has become a very popular activity for children.

Opinions concerning children participating in long distance running are varied. Kenney (1981) states that running is a natural activity for the child. Brueck (1979) questions the value of children running a marathon. Long distance running places a severe strain on the articular cartilage, which could lead to adverse growth effects, particularly epiphyseal injury and subsequent disturbed growth in the affected limb. Physicians, educators, and scientists are less opinionated in view of the lack of scientific evidence (Caine & Lindner, 1984). Medical documentation of injury to children running long distances is very limited.

The purpose of this study was to investigate the effects of selected physiological variables on preadolescent male and female long distance runners. The investigation entailed an assessment of selected physiological characteristics of trained preadolescent children involved in long distance running and a control group of untrained children. The trained group was comprised of 8-, 9-, and 10-year-old males and females who had been running a minimum of 20 miles per week for 2 months or longer. The mean age was 9.5 years; the mean weight was 32.85 kg (72.42 lbs.); and the mean height was 140.91 cm (55.4 in.). A second group of 8-, 9-, and 10-year-old males and females who had not undertaken a regular schedule of exercise and/or were not participating in an organized

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recreational sport served as the untrained group. The mean age was 9.05 years; the mean weight was 33.35 kg (73.54 lbs.); and the mean height was 134.6 cm (52.99 in.). The physiological parameters compared were maximum oxygen consumption, bone density width, cortical score, and bone mineral content. Bone density width - the thickness of the bone. Bone mineral content - the percentage of chemical constituents contained within bone. Calcium phosphate, calcium carbonate, with lesser quantities of sodium, magnesium, and fluoride. Cortical Score - The total width of the bone compared to cortical bone.

METHODS AND PROCEDURES

Each subject's voluntary maximum oxygen consumption was measured during work on a Quinton treadmill, using the Bruce protocol. The Tissot Chain-Compensated Gasometer was used to collect all gases. The S-3A Oxygen Analyzer and the Beckman Medical Gas Analyzer were used to analyze the oxygen and carbon dioxide content of the collected gases. Bone density width was determined by x-ray densitometry of the radius. A radiograph was taken of the subject's left radius using a 60 kv peak Picker mobile x-ray unit. The exposed film was processed according to standardized technique. Bone denisty width was evaluated at the radius and phalanx 5.2.

The exposed film was evaluated for cortical score by measuring the thickness of the walls and the total width of the bone of the metacarpal II-4, using a magnifying glass. The 2 scores were added together and divided by the total width of the bone. The cortical score of the metacarpal III-4 was determined in a similar method.

Bone mineral content was determined by utilizing a Norland-Cameron Bone Mineral Analyzer. Depending upon subject movement, 4 or 5 scans were taken. A digital numerical readout for bone mineral content appeared on the screen after the completion of each scan. The mean of the 4 or 5 scans were calculated. Twenty-four (24) subjects completed a 3-day dietary recall.

RESULTS

Data collected from the 20 trained and 20 untrained subjects were analyzed to determine if there was a difference between the groups for each physiological characteristic measured, using the multivariate analysis of variance.

1. There was a significant difference between the maximum oxygen consumption of the runners and the untrained. The maximum oxygen consumption of the runners (45.08 ml/kg/min) was higher than the untrained (33.05 ml/kg/min).

2. There was a significant difference between the runners and the untrained for bone mineral content. The bone mineral content of the runners was greater than that of the untrained.

3. When the bone density width-radius of the runners was compared with the untrained, there was not a significant difference.

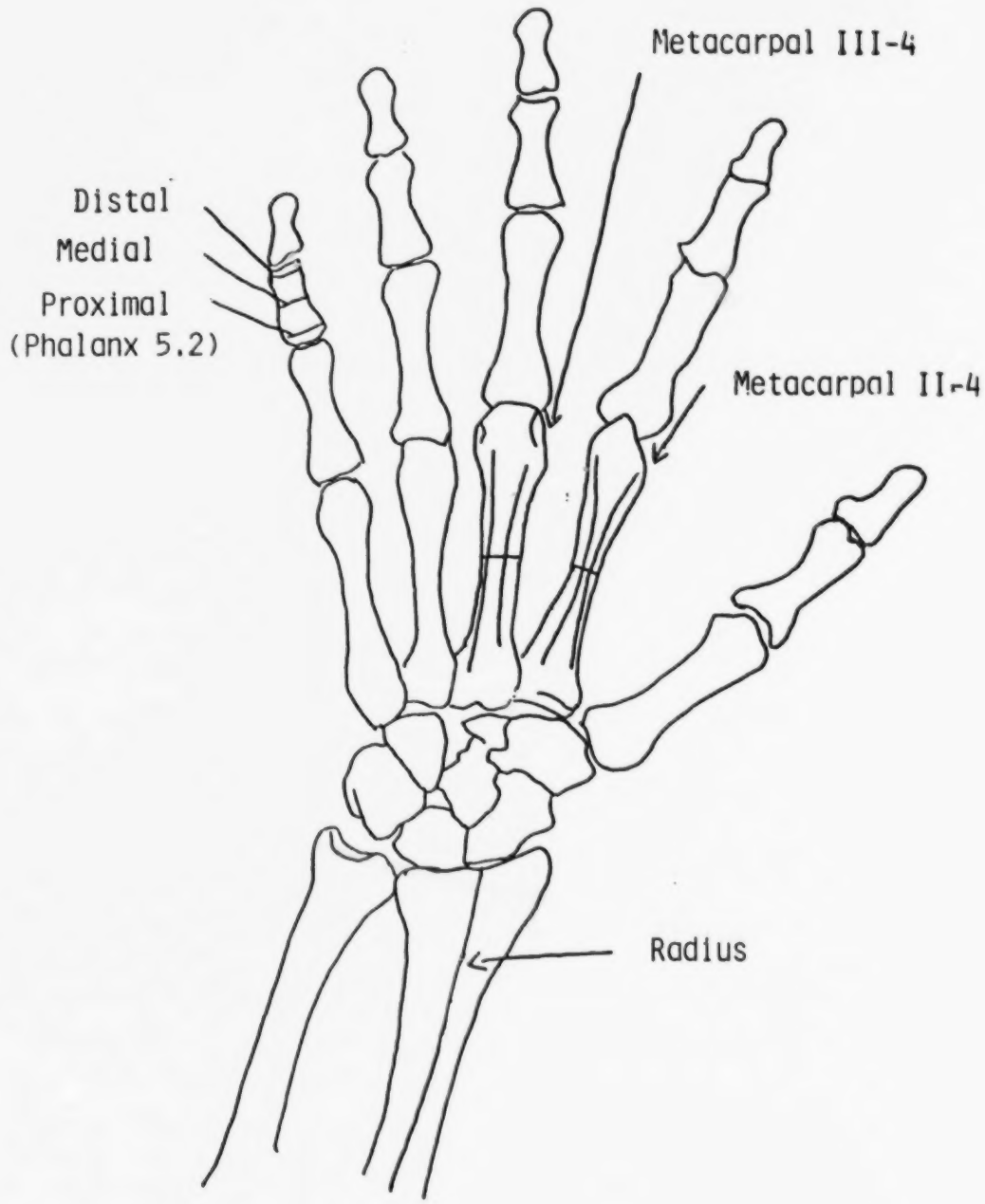
4. There was a significant difference between the runners and the untrained group for bone density width-phalanx 5.2. The F-ratio was 5.15. The bone density width-phalanx 5.2 was greater than that of the untrained.

5. There was not a significant difference found for the cortical score-metacarpal II-4 and metecarpal III-4.

6. There was not a significant difference between the runners and the untrained group for the nutritional intake of calcium, phosphorus, vitamin A, vitamin D, protein, or kilocalories.

CONCLUSION

The findings of this investigation suggest that participating in long distance running was advantageous for the runners. It was concluded that long distance running may have affected the bone density width, bone mineral content, and maximum oxygen consumption in a positive way.



Sites investigated

Table 1

Description of the Subjects

Group Variables	Range	M	SD	SEM
Runners	2.00			
Age	8.00 - 10.00	9.50	.76	.17
	22.91			
Weight (kg)	22.00 - 44.91	32.85	7.26	1.62
	42.16			
Height (cm)	122.94 - 165.10	140.91	10.21	2.28
	23.30			
Maximum Oxygen Consumption (ml/kg·min)	35.30 - 58.60	45.08	7.06	1.86
	1.25			
Maximum Oxygen Consumption (l/min)	.95 - 2.20	1.48	.46	.10
	3474.3			
Ventilation (ml/min)	2600.5 - 6074.8	4297.9	890.98	199.23
Cortical Score (mg/cm)	.33			
Metacarpal II-4	.32 - .64	.49	.07	.02
	.36			
Metacarpal III-4	.28 - .64	.46	.90	.02
Bone Density Width (mg/cm)	.16			
Phalanx 5-2	.16 - .32	.20	.04	.00

table continues

Group Variables	Range	M	SD	SEM
Runners				
Radius	.19 .20 - .39	.31	.04	.00
Bone Mineral Content (g/cm^2)	.30 .42 - .72	.52	.06	.01
Untrained				
Age	2.00 8.00 - 10.00	9.05	.83	.18
Weight (kg)	27.67 20.41 - 48.08	33.35	16.49	3.69
Height (cm)	32.02 115.57 - 148.59	134.60	9.30	1.97
Maximum Oxygen Consumption (ml/kg·min)	25.40 20.50 - 45.90	33.05	.30	.85
Maximum Oxygen Consumption (l/min)	1.02 .73 - 1.75	1.10	.32	.07
Ventilation (ml/min)	3570.1 2054.57 - 5624.67	3419.31	990.32	221.44
Cortical Score (mg/cm) Metacarpal II-4	.23 .32 - .55	.45	.06	.01

table continues

Group Variables	Range	M	SD	SEM
Untrained				
Metacarpal III-4	.25 .30 - .55	.42	.07	.02
Bone Density Width (mg/cm)				
Phalanx 5-2	.11 .13 - .24	.18	.03	.00
Radius	.13 .22 - .35	.30	.03	.00
Bone Mineral Content (g/cm^2)	.10 .44 - .55	.17	.03	.05

Table 2

Summary of Multivariate Analysis of Variance

Source	df	ss	MS	F	p
A: Fitness Level					
Age	1	2.02500	2.025	3.16	.0841
Metacarpal II-4	1	.00992	.00992	2.08	.1579
Metacarpal III-4	1	.01640	.01640	2.92	.0959
Phalanx 5.2	1	.00625	.00625	5.15*	.0294*
Radius	1	.00169	.00169	1.17	.2865
Mineral	1	1.17306	1.17306	37.45*	.0000*
VO_2 Max	1	1449.50000	1449.50000	24.31*	.0000*
B: Sex					
Age	1	.62500	.62500	0.97	.3303
Metacarpal II-4	1	.00004	.00004	0.01	.9239
Metacarpal III-4	1	.03540	.03540	6.31*	.0166*
Phalanx 5.2	1	.00004	.00004	0.03	.8570
Radius	1	.00064	.00064	0.44	.5098
Mineral	1	.05402	.05402	1.72	.1974
VO_2 Max	1	33.14220	33.14220	0.56	.4608

table continues

Source	df	ss	MS	F	p
AB:Interaction					
Age	1	.22500	.22500	0.35	.5574
Metacarpal II-4	1	.00246	.00246	0.52	.4769
Metacarpal III-4	1	.01190	.01190	2.12	.1539
Phalanx 5.2	1	.00025	.00025	0.21	.6527
Radius	1	.00000	.00000	0.00	1.0000
Mineral	1	.03782	.03782	1.21	.2291
VO_2 Max	1	73.46800	73.46800	1.23	.2743
Error					
Age	36	23.10000	.06416		
Metacarpal II-4	36	.17176	.00477		
Metacarpal III-4	36	.20197	.00561		
Phalanx 5.2	36	.04369	.00121		
Radius	36	.05197	.00144		
Mineral	36	1.12766	.03132		
VO_2 Max	36	2146.52410	59.62566		

* $F_{.95}(1,36) > 4.10$

Table 3

Description of the Nutrients

Group Variables	Range	M	SD	SEM
Runners				
Calcium (mg)	1588.0 370.0 - 1958.0	952.5	403.8	116.6
Phosphorus (mg)	1388.8 567.2 - 1956.0	1126.0	413.0	119.2
Vitamin A (RE)	292.0 251.0 - 543.0	776.4	495.4	143.0
Vitamin D (µg)	.4 .4 .8	.6	.1	.4
Protein (g)	80.5 28.2 - 108.8	63.8	22.8	6.6
Kilocalories	1912.1 953.9 - 2866.0	1818.0	559.1	161.4
Untrained				
Calcium (mg)	2866.5 173.5 - 3040.0	983.9	784.6	226.5
Phosphorus (mg)	2799.0 163.0 - 2942.0	1130.0	731.7	211.2
Vitamin A (RE)	445.9 145.7 - 591.6	710.8	553.2	159.6
Vitamin D (g)	.1 .0 - .1	.1	.1	.1

table continues

Group Variables	Range	M	SD	SEM
Protein (g)	42.0 105.0 - 147.0	60.9	36.9	10.7
Kilocalories	3083.7 475.3 - 3559.0	1759.0	831.4	240.0

Table 4

Dietary Recall

Source	df	ss	MS	F	p
Fitness Level					
Calcium	1	5899.44	5899.44	0.02	.9031
Phosphorus	1	141.81	141.81	0.00	.9842
Vitamin A	1	684238.00	684238.00	0.10	.7556
Vitamin D	1	19971.70	19971.70	2.81	.1076
Protein	1	51.07	51.07	0.05	.8180
Kilocalories	1	20995.30	20995.30	0.04	.8398
Error					
Calcium	22	8564195.40	389281.61		
Phosphorus	22	7764998.10	352954.46		
Vitamin A	22	15157482.00	6889764.70		
Vitamin D	22	156102.96	7095.58		
Protein	22	20709.81	941.35		
Kilocalories	22	11041253.00	501875.14		

*$F_{.95}$ (1.22) > 4.30

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